

MARKSCHEME

May 2005

BIOLOGY

Higher Level

Paper 3

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General Marking Instructions

Subject Details: Biology HL Paper 3 Markscheme

Mark Allocation

Candidates are required to answer **ALL** questions in each of **TWO** Options (total **[20 marks]**). Maximum total = **[40 marks]**.

General

A markscheme often has more specific points worthy of a mark than the total allows. This is intentional. Do not award more than the maximum marks allowed for part of a question.

When deciding upon alternative answers by candidates to those given in the markscheme, consider the following points:

- ♦ Each marking point has a separate line and the end is signified by means of a semicolon (;).
- ♦ An alternative answer or wording is indicated in the markscheme by a “/”; either wording can be accepted.
- ♦ Words in (...) in the markscheme are not necessary to gain the mark.
- ♦ The order of points does not have to be as written (unless stated otherwise).
- ♦ If the candidate’s answer has the same “meaning” or can be clearly interpreted as being the same as that in the mark scheme then award the mark.
- ♦ Mark positively. Give candidates credit for what they have achieved, and for what they have got correct, rather than penalising them for what they have not achieved or what they have got wrong.
- ♦ Remember that many candidates are writing in a second language. Effective communication is more important than grammatical accuracy.
- ♦ Occasionally, a part of a question may require a calculation whose answer is required for subsequent parts. If an error is made in the first part then it should be penalized. However, if the incorrect answer is used correctly in subsequent parts then **follow through** marks should be awarded.
- ♦ Units should always be given where appropriate. Omission of units should only be penalized once. Ignore this, if marks for units are already specified in the markscheme.
- ♦ Do not penalize candidates for errors in significant figures, unless it is specifically referred to in the markscheme.

Option D — Evolution

- D1.** (a) (i) 63 (%) (± 1) [1]
- (ii) 54 snakes (± 3) (*Accept whole integers only e.g. 53 not 53.4*) [1]
- (b) *Answers must show comparisons to receive full marks. Award [1 max] for descriptions that are not connected.*
 banded snakes at higher frequency on mainland than on the islands / appropriate numerical comparison / unbanded snakes at higher frequency on island than on the mainland;
 Ontario has greatest percentage of banded snakes while Middle and Pelee Island has the greatest percentage of unbanded snakes;
 Ontario has no unbanded snakes while the islands have banded and unbanded snakes;
 more variation on the islands than on the mainland;
 islands furthest from the mainland have the highest percentage unbanded; [3 max]
- (c) banded snakes are predated on / do not survive on the island due to natural selection / unbanded snakes have better camouflage on the islands so they are not predated; migration every year returns banded snakes to the population; [2]
- D2.** (a) the amount of time taken for radioactivity to decay to half its original level [1]
- (b) half-life for ^{40}K is 1250 million years;
 useful for dating very old rocks older than 100 000 years;
 measure the proportion of ^{40}K / ^{40}Ar (in rocks);
 molten rock releases ^{40}Ar starting the clock;
 as ^{40}K decays into ^{40}Ar it is trapped in rock / ^{40}K only where there are layers of volcanic rock / ash; [2 max]

- D3.** (a) RNA self-replicates / self-replication has been shown experimentally;
 RNA thought to have served as first genes not DNA;
 it can act as an enzyme / called a ribozyme / RNA has catalytic properties;
 (recently discovered that) RNA can catalyse formation of more RNA (*e.g.* tRNA / rRNA / mRNA);
 RNA can bind amino acids for the formation of peptide linkages;
 RNA can also be transcribed into DNA (using reverse transcriptase); **[4 max]**

- (b) *foramen magnum* moved backwards gives a better balance to the head;
 legs became longer and stronger / bigger *gluteus maximus* and *gastrocnemius* / calf muscle to permit wading through water/swamps/marshland / permits control of forward movement;
 knees/valgus angle changed to allow the leg to straighten fully;
 foot became more rigid with arches for shock absorbing;
 a non-opposable big toe for thrust / can no longer be used for grasping;
 lumbar curve so torso is upright;
 wide hips/pelvis to support abdominal organs;
 walking long distances/migrating / more efficient than knuckle-walking;
 hands freed for tool use;
 can carry food / water / children over long distances / more provisioning possible;
 tree climbing became more difficult;
 less surface area exposed to sun;
 increased visibility/field of vision (over grassland for predators / resources); **[6 max]**

Option E — Neurobiology and Behaviour

- E1.** (a) 24 % (± 2 %) (*units required*) [1]
- (b) 8 (± 0.5) : 42 (± 0.5) **or** 16 (± 1) : 84 (± 1) **or** 1 : 5.25 (± 0.25) [1]
Accept the following alternative 11:44 (± 0.5) and 1:4 (± 0.25).
- (c) small females have more saturated lipids than large females / large females have more unsaturated lipids than small females;
 large females have a peak (unsaturated lipids) at 26 minutes while small females do not have a peak present;
 large females have two peaks (unsaturated and saturated) at 23 minutes while small females do not;
 large peaks for small females are emerging sooner than for large females; [2 max]
- (d) (i) apply lipids to substrate / skin of snake;
 then introduce male snake and record preference;
 use of control; [2 max]
- (ii) larger females have larger / more offspring;
 better survivorship of offspring; [1 max]
- E2.** (a) behaviour that occurs in all members of a species despite variation in the environment / inherited behaviour / stereotyped behaviour / not learnt/instinctive [1]
- (b) shine light in eye to see if pupil constricts;
 pupil reflex is a cranial reflex/ANS reflex/controlled by the brainstem;
 (if pupil reflex is lost) patient is most likely brain dead;
 some drugs (barbiturates) / nerve damage may interfere with pupil reflex; [2 max]

- E3.** (a) psychoactive drugs affect the mind/brain and personality;
change/increase synaptic transmission;
(drugs) can block/similar in structure/inhibit breakdown of neurotransmitter;

Award [2 max] per example, e.g. cocaine / nicotine / amphetamines.

Accept only affects on the synapse and behavioural affects.

cocaine/crack;

stimulates synaptic transmission of adrenergic synapses;

increased energy/alertness/euphoria;

nicotine;

stimulates synaptic transmission of cholinergic synapses;

has a calming effect;

amphetamines/ecstasy;

stimulates synaptic transmission of adrenergic synapses;

similar effects to cocaine;

longer lasting effect / 2 to 4 hours;

[6 max]

- (b) both are part of the autonomic nervous system;
antagonistic to each other / counteracts;
the sympathetic prepares the body for action while the parasympathetic returns the body function to normal;
example of any effect comparing the action of the sympathetic and parasympathetic systems in a tissue or organ (e.g. heart: sympathetic increases output and parasympathetic returns it back to normal);
a second example;

[4 max]

Option F — Applied Plant and Animal Science

- F1.** (a) (i) bromoxynil [1]
- (ii) allinol [1]
- (iii) 47 (%) [1]
- (b) surfactants may help some herbicides in weed control;
no effect of surfactant when using bromoxynil;
surfactant helped with 2,4-D and glyphosphate;
all surfactants helped equally with 2,4-D;
glyphosphate was helped with by MON 0818 and oxysorbic;
allinol interferes with/reduces effect of glyphosphate (herbicide); [3 max]
- F2.** (a) sheep (milk) produce factor IX for blood clotting;
winter flounder fish gene to make tomatoes frost resistant;
 α -1 antitrypsin in sheep;
interferon in cows milk;
spider silk protein into sheep; [2 max]
Award any other examples which involve animals as sources of genes or as the genetically modified organism.
- (b) antibiotics increase growth rates by controlling infection;
can boost production of milk and meat so more food available;
less illness / suffering in animals;
allow high density / intensive farming;
named example of a disease *e.g. Brucellosis*; [2 max]

- F3.** (a) flowering in LDP controlled by the plant's biological clock;
uses phytochrome to measure dark period / Pr converted to Pfr during daylight;
LDP needs a day length longer than a critical period / night length shorter than a critical period;
Pfr remains at the end of short nights;
Pfr stimulates flowering;
flowering hormone / florigen released;
phytochrome system / biological clock located in leaf;
example of LDP; **[4 max]**

- (b) *arguments for:* **[4 max]**
either/both can increase yields in crops / reduces famine/starvation in same areas;
pesticides can kill organisms that transmit diseases;
biological controls are safer for health and environment;
either/both costs may be reduced for the farmer;
either/both can be very specific with respect to the pest;

arguments against: **[4 max]**

- biological controls can harm ecosystem introducing alien organisms;
pesticide residues may be in food / water consumed by humans;
pests may develop resistance to pesticides;
non-target species may be harmed;
workers may suffer health problems when using pesticides;
pesticides can move through food chain harming top carnivores / birds of prey; **[6 max]**

Option G — Ecology and Conservation

- G1.** (a) $19580 \text{kJm}^{-2} \text{yr}^{-1}$ (*units required*) [1]
- (b) (i) autotrophs lose 55 % of their gross products to heat compared with the heterotrophs which lose 96.3 % (96) of their food energy / 41 % more of heterotrophs; [1]
Numerical comparison required
- (ii) animals use a lot of energy to move / maintenance of body temperature / other valid reasons [1]
- (c) decomposers are responsible for the recycling of (inorganic) nutrients / breakdown of organic molecules to inorganic compounds [1]
- (d) autotrophs need nutrients (from the soil);
 decomposers release these nutrients;
 fewer decomposers will lead to slower / less recycling of nutrients;
 limits growth of autotrophs;
 limits (net/gross) productivity of autotrophs; [2 max]
- G2.** (a) no two species can coexist (in the same community) if they share the same (ecological) niche / when two species compete directly for a limiting resource one species eliminates the other [1]
- (b) cheaper than *ex situ* conservation;
 species continues to evolve in the natural environment;
 larger populations can be maintained bigger breeding pool / more genetic variation;
 species will be behaving normally in the natural environment / less stress / injury to animals during capture / transport;
 species will not have to adapt to special diets;
 species can have large territories/space; [3 max]

G3. (a) arguments for: [4 max]

50 % of known species found in tropical rainforests / tropical rainforests contain other species yet to be discovered;
destroying tropical rainforests will cause extinction of species;
destroying tropical rainforest will cause climate change;
tropical rainforests are a sink for CO₂;
tropical rainforests prevent soil erosion / loss of top soil;
pharmaceuticals can be derived from tropical rainforests species;
ecotourism is a source of revenue for countries with tropical rainforests;
tropical rainforests provide food / materials for local populations;
provides organisms / environments for education / research;

arguments against: [4 max]

conservation measures may slow economic development of countries with tropical rainforests;
clearing tropical rainforests provides land for agriculture;
tropical rainforests species can be reservoirs for pest species / species which transmit diseases;
clearing rainforests opens up communication routes;

[6 max]

- (b) addition of fertilizers containing plant material/compost / plowing in stubble;
addition of fertilizers containing animal waste;
addition of fertilizers containing (synthetic) nitrates / ammonium salts;
plowing increases aeration for nitrification;
plowing increases drainage reducing denitrification;
crop rotation using nitrogen fixing crops/legumes;
letting fields go fallow periodically decreases denitrification / increases nitrogen fixation;

[4 max]

Option H — Further Human Physiology

- H1.** (a) (i) 2.6 (± 0.2) nmol mg⁻¹ liver tissue (*units required*) [1]
- (ii) 6.4 (± 0.3) nmol mg⁻¹ liver tissue (*units required*) [1]
- (b) injection reduces the total glutathione content in liver tissue;
by about 45 % / 2.4 nmol mg⁻¹;
reduced glutathione content is reduced by about 41 % / by 1.8 nmol mg⁻¹;
smaller proportion of glutathione is oxidized; [2 max]
- (c) pre-treatment with flaxseed increases glutathione content over control levels;
cells exposed to tetrachloromethane with pre-treatment with flaxseed maintained higher
glutathione levels than without pre-treatment;
so cells would show less damage when exposed to free radicals;
hard to evaluate due to short period of investigation; [3 max]
- H2.** (a) 1: villus – absorption of (soluble) food / for mixing of food with secretions / increased
surface area for digestion (*e.g.* disaccharides);
2: lacteal / lymphatic duct/vessel – transport of fat/lipid; [2]
- (b) 3: circular;
4: longitudinal; [1]
Both needed to receive [1].

- H3. (a)** carbon dioxide is carried in three forms in the blood;
carbon dioxide can be dissolved in the blood / plasma;
carried as dissociated carbonic acid / H_2CO_3 / $\text{H}^+ + \text{H}_2\text{CO}_3^-$;
carried as carbaminohemoglobin / bound to hemoglobin;
carbonic anhydrase found in red blood cells/erythrocytes;
carbonic anhydrase speeds up production of hydrogen carbonate / bicarbonate / HCO_3^- ;
chloride shift / movement of chloride ions into red blood cell/erythrocyte occurs to
balance movement of hydrogen carbonate / bicarbonate / HCO_3^- ion movement out; **[4 max]**
- (b)** *Award [4 max] for:*
produced in hypothalamus;
via neurosecretory cells;
passes from hypothalamus to (posterior) pituitary;
attached to carrier protein / neurophysin;
(stored) in posterior pituitary / neurohypophysis;
released under stimulus by osmoreceptors in hypothalamus;
osmoreceptors stimulated by high blood plasma concentration/reduced blood pressure;
increases water reabsorption (in kidneys);
- Award [2 max] for:*
site of action is collecting duct;
promotes constriction of blood vessels;
increases blood pressure;
there is a negative feedback control of ADH/vasopressin secretion; **[6 max]**
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